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(54) Optical fiber connector terminal and method of making same

Faseroptischer Stecker und Methode zu seiner Herstellung

Terminaison d'un connecteur à fibre optique et sa méthode de fabrication

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Description

The present invention relates to an optical fiber terminal connector having a sleeve accommodating a plurality of pins equidistantly arranged side by side about the center axis of the sleeve so as to form an elongated fiber receiving passageway and grooves of V-shaped cross-section which are formed between adjacent external surfaces of the pins, a plurality of filler rods between the sleeve and the pins and an optical fiber extending through the fiber receiving passageway. Moreover, the present invention relates to a method of making such an optical fiber terminal connector which includes the step of placing a plurality of pins side by side in a sleeve in such a manner that the pins define an elongated fiber receiving passageway and with external surfaces of the pins forming V-shaped grooves.

Such optical fiber terminal connectors are used for closely connecting cords or cables of optical fibers for communication systems, data transmission systems and other optical systems.

An optical fiber terminal connector of the type mentioned above is already known from EP-A2 0 154 262. In said known connector at least one of the pins has to be elastic in order to clamp the optical fiber between the pins. The optical fiber is fixed in its position by inserting filler rods into the sleeve after the optical fiber has been inserted. Another connector using clamping for fixing the optical fiber is known from US-A-4,773,725. Moreover, from US-A-4,201,443, it is known to use pins made of glass which are fixed relative to each other by a thermal fusing process.

Generally in optical fiber transmission lines, the connection between optical fibers is critical. The connection of optical fibers requires a precise registration of optical fibers. Optical fibers are made from glass and have a diameter of 100 microns. There are two requirements for the connector terminals; protecting and reinforcing the optical fibers and registering optical fibers with high-precisions in the order of micrometers.

In an attempt to satisfy such requirements, an optical fiber connector terminal such as shown in Fig. 24 has been proposed. This connector terminal includes a terminal body 40 which is made from zirconia ceramic. The terminal body 40 is made by molding a terminal body which is slightly larger than the finished product, sintering it at high temperatures, and grinding a receiving aperture 41 with a wrapping wire or the like to the desired size. The terminal body 40 is then press fitted into a support member 42.

However, it is very difficult to make a long core pin of the mold for the receiving aperture 41 so that it is very difficult to make a thin long receiving aperture 41 which is longer than 10 mm. For this reason, the strength of an optical fiber bonded to the conventional receiving aperture 41 is so small that the finished product is not reliable.

The zirconia ceramic materials require sintering at high temperatures, making the manufacturing process complex and difficult, resulting in the low yield. In addition, thin connector terminals between 1.0 and 1.5 mm in diameter have low bending resistance and are easy to break upon connection and disconnection.

Even if the connector terminal is made from a metal, it is extremely difficult to make a thin long receiving aperture in the connector terminal. Moreover, the terminal body 40 and the support member 42, which are made from different materials, are not compatible and can break upon forcible connection.

With respect to the above, the present invention intends to provide an optical fiber terminal connector of the type as claimed by the preamble portion of claim 1 which has a high stability and thereby allows precise positioning of the optical fiber and easy assembly, and a method for making such a connector.

According to the present invention there is provided an optical fiber terminal connector of the type mentioned at the beginning wherein the V-shaped grooves between adjacent pins are filled by permanently deformed material of the sleeve and the deformed filler rods which are pressed into the V-shaped grooves and wherein the optical fiber is bonded into said fiber receiving passageway.

In the above connector terminal, the sleeve, the filler rods, and the pins are integrated so that the pins are fixed to provide a thin long receiving aperture, thereby providing a long connector terminal. This increases the bonding strength of an optical fiber to the receiving aperture and thus the connector reliability.

According to the present invention there is also provided a method of making such an optical fiber terminal connector, as defined in the preamble portion of claim 9 and which is characterized by the insertion of filler rods into the V-shaped grooves and by steps of reducing the diameter of the sleeve by inwardly permanently deforming the sleeve and the rods so that deformed material of the sleeves and the filler rods fills the V-shaped grooves between adjacent pins thereby fixing the pins in their positions relative to each other and subsequently bonding an optical fiber in the elongated fiber receiving passageway.

By the above method it is possible to make a connector terminal having a thin long receiving aperture without difficulty.

The above and other features and advantages of the invention will become more apparent from the following description when taken in conjunction with the accompanying drawings.

Fig. 1 is a perspective view of an optical fiber connector having a connector terminal according to a first embodiment of the invention;

Fig. 2 is a perspective view of the connector terminal of Fig. 1;

Fig. 3 is a longitudinal section of the connector terminal of Fig. 1;

Fig. 4 is a rear view of the connector terminal of Fig. 1;
Fig. 5 is a front view of a terminal body of the connector terminal of Fig. 1;
Fig. 6 is a perspective view showing how to grind a pin for making the connector terminal of Fig. 1;
Fig. 7 shows how to cut a pipe for making a sleeve for the connector terminal of Fig. 1;
Fig. 8 shows how to make a specified inner diameter in the sleeve of Fig. 7;
Figs. 9 and 10 show three pins and three filler rods placed in the sleeve;
Figs. 11-13 show a connector terminal material with a triangular aperture at the center;
Fig. 14 shows how to cut off end portions of the connector terminal material;
Fig. 15 is a cross section of the connector terminal material;
Fig. 16 illustrates how to wrap the triangular aperture to form a circular receiving aperture;
Fig. 17 shows how to grind the circumference of the connector terminal material with a cylindrical grinder;
Fig. 18 illustrates how to polish an end of the connector terminal material;
Fig. 19 shows how to make a guide surface in the receiving aperture;
Fig. 20 illustrates how to round a corner of the connector terminal material;
Fig. 21 is a longitudinal section of the connector terminal material in which an optical fiber is bonded;
Figs. 22 and 23 are end views of a connector terminal according to a second embodiment of the invention before and after the application of a rotary forging process, respectively; and
Fig. 24 is a longitudinal section of a conventional connector terminal.

In Fig. 1, the optical fiber connector includes a plug 1 and an adapter 2. The plug 1 has a plug housing 3 for housing an optical fiber connector terminal 5 via a retainer fixture 4.

As Figs. 2-5 show, the connector terminal 5 consists of a support member 5a with a flange 5c and a terminal body 5b attached to the support member 5a. The terminal body 5b has a sleeve 6 in which three pins 7 are placed with filler rods 8 filling in spaces between the sleeve 6 and the pins 7. An optical fiber 10 of a fiber cable 50 is bonded to a receiving aperture 9 defined by the three pins 7. The filler rods 8 and the sleeve 6 are subjected to a rotary forging process in a rotary swage, for example, to be reduced in diameter so that the filler rods 8 fills spaces between the sleeve 6 and pins 7 while the three pins 7 are disposed equidistantly from a center O, thereby placing the optical fiber 10 at the center O.

As has been described above, the three pins 7 are disposed equidistantly from the center O within the sleeve 6 to form a receiving aperture 9 at the center O. The filler rods 8 are provided in spaces between the sleeve 6 and the pins 7, and the sleeve 6 is reduced in diameter so that the filler rods 8 fill spaces between the sleeve 6 and the pins 7. The optical fiber 10 is bonded in the receiving aperture 9. As a result, the sleeve 6, the filler rods 8, and the pins 7 are integrated to hold the pins 7 in place, thereby forming a thin long aperture 9. This makes it possible to make a long connector terminal. Consequently, the bonding strength of the optical fiber 10 to the receiving aperture 9 is increased, resulting in an increased connector reliability.

A method of making such an optical fiber connector terminal 5 will be described below with reference to Figs. 6-21.

As shown by Fig. 6, pin material 7a which is made of stainless steel is cut to a predetermined length (for example, 60mm), subjected to a heat treatment or hardening process, and ground in a grinder 11 to form a pin 7. The pin 7 has a predetermined degree of circularity and a predetermined degree of surface smoothness. The grinder 11 consists of a support member 12 for supporting the pin material 7a and a pair of grinding rollers 13 and 14, which rotate in opposite directions shown by arrows to grind the pin material 7a. Thus, the pin 7 is made from a hardened stainless steel material (for example, SUS 305).

In Fig. 7, in order to make a sleeve 6, a stainless steel pipe 15 is cut to a predetermined length.

In Fig. 8, an opening 17 of a specified inner diameter is made with a drill 16 or the like. Unlike the pin 7, the resulting sleeve 6 is made from stainless steel which is not hardened so that its hardness is less than that of the pin 7.

In Figs. 9 and 10, three pins 7 and three filler rods 8 are alternatingly disposed within the sleeve 6. The pins 7 are dimensioned such that they form a substantially triangular cross section, each apex of which contacts the inside of the sleeve 6. The filler rods 8 having a circular or fan shaped cross section are made from stainless steel which is not hardened. Consequently, their hardness is substantially equal to that of the sleeve 6 and less than that of the pins 7.

In Figs. 11-13, the sleeve 6 having the three pins 7 and the three filler rods 8 therein is subjected to a rotary forging process, for example, in a rotary swage to reduce the diameter. The rotary forging process is a process by which the sleeve 6 is struck by one or two pairs of forging dies under continuous or intermittent rotation about its axis, thereby forming a connector terminal material A. The rotary forging process makes the filler rods 8 collapse to fill spaces between the sleeve 6 and the pins 7, thereby disposing the three pins 7 equidistance from the center O.

In Fig. 14, opposite end portions of the connector terminal material A are cut off with a pair of fine cutters 19. The cutting surfaces are smoothed and cleaned.

In Fig. 15, a receiving aperture 20 of a substantially triangle cross section is formed at the center of the three pins 7. A receiving aperture 9 of a circular cross section into which an optical fiber is to be inserted is made from the triangle aperture 20.

In Fig. 16, a wrapping wire 21 is put through the triangle aperture 20. Grinding diamond granules 22 are put on the wrapping wire 21. A pair of reels 23 and 24 are turned back and forth to reciprocate the wrapping wire 21 to grind the wall of the receiving aperture 20.

In Fig. 17, the outside of the connector terminal material A is polished with a cylindrical grinder 25 to provide the desired degree of concentricity.

In Fig. 18, an end surface of the terminal material A is polished with a grinder 27 while being held in place with a holder 26 to provide a right angled end surface.

In Fig. 19, a guiding surface 28 is made at an end of the receiving aperture 9 by an electric discharge process using an electrode 29. Alternatively, the guiding surface 28 may be made by a cutting process.

In Fig. 20, an end of the terminal material A is ground with a grinder 30 to provide a rounded corner. The terminal material A is then cleaned and press fitted into a support member 5a for integration.

In Fig. 21, an adhesive 33 is put in the receiving aperture 9, and an optical fiber 10 is put through the receiving aperture 9, thereby building up the adhesive 33 at the end surface so that the projected portion of the optical fiber 10 is also bonded. The built up adhesive 33 and the projected optical fiber 10 are ground off with a grinder to provide a connector terminal 5.

Figs. 22 and 23 show a second embodiment of the invention, wherein five pins 7 and five filler rods 8 are disposed within the sleeve 6 such that they contact the adjacent pins, the filler rods, and the inside of the sleeve 6. An optical fiber 10 is inserted and bonded in a receiving aperture 9 defined by the five pins 7. The filler rods 8 and the sleeve 6 are subjected to rotary forging in a rotary swage, for example, so that the filler rods 8 fill spaces between the sleeve 6 and the pins 7 to dispose the five pins 7 equidistantly from the center O, thereby disposing the receiving aperture 9 at the center O for the optical fiber 10. By using the five pins 7, it is possible to provide a connector terminal with a receiving aperture having a diameter greater than that of the three pin connector terminal.

The five pin connector terminal is made in the same way as that of the three pin connector terminal.

Alternatively, the filler rods 8 having a circular cross section in the above embodiments may have a triangular or polygonal cross section. The sleeve 6 and the filler rods 8 made from stainless steel which is not hardened may be made from tungsten or beryllium as far as their hardness is less than that of the pins 7 which are made from hardened stainless steel such as SUS 305. The sleeve 6 having the pins 7 and the filler rods 8 were reduced in diameter by a rotary forging in a rotary swage in the above embodiment, but the same results may be obtained by a drawing or press machine.

Claims

1. An optical fiber terminal connector having a sleeve (6) accommodating a plurality of pins (7) equidistantly arranged side by side about the centre axis of the sleeve (6) so as to form an elongated fiber receiving passageway (9) and grooves of V-shaped cross-section which are formed between adjacent external surfaces of the pins (7), a plurality of filler rods (8) between the sleeve (6) and the pins (7) and an optical fiber (10) extending through the fiber receiving passageway (9), characterized in that the V-shaped grooves between adjacent pins (7) are filled by permanently deformed material of the sleeve (6) and the deformed filler rods (8) which are pressed into said V-shaped grooves and that the optical fiber (10) is bonded into said fiber receiving passageway (9).

2. The optical fiber terminal connector according to claim 1, **characterized in that** three pins (7) are arranged within the sleeve (6).

3. The optical fiber terminal connector according to claim 1, **characterized in that** five pins (7) are arranged within the sleeve (6).

4. Optical fiber terminal connector according to one of claims 1 to 3, **characterized in that** the filler rods (8) in their undeformed state have a circular cross-sectional area and are arranged within the V-shaped grooves between adjacent pins (7).

5. Optical fiber terminal connector according to one claims 1 to 4, **characterized in that** the filler rods (8) in their undeformed state have a triangular cross-sectional area and are arranged within the V-shaped grooves between adjacent pins (7).

6. Optical fiber terminal connector according to one of claims 1 to 4, **characterized in that** the filler rods (8) in their undeformed state have a polygonal cross-sectional area and are arranged within the V-shaped grooves between adjacent pins (7).

7. Optical fiber terminal connector or method according to one of claims 1 to 6, **characterized in that** the pins (7) arranged within the sleeve (6) have a higher resistance against deformation than the sleeve and the filler rods (6, 8).

8. Optical fiber terminal connector or method according to one of claims 1 to 7, **characterized in that** the pins (7) are made of hardened stainless steel whereas the sleeve and the filler rods (6, 8) are made of non-hardened stainless steel.

9. A method of making an optical fiber terminal con-

nector as claimed in claim 1 including the step of placing a plurality of pins (7) side by side in a sleeve (6) in such a manner that the pins (7) define an elongated fiber receiving passageway (9) and with external surfaces of the pins forming V-shaped grooves, **characterized by** the insertion of filler rods (8) into the V-shaped grooves and by the steps of reducing the diameter of the sleeve (6) by inwardly permanently deforming the sleeve (6) and the rods so that deformed material of the sleeve (6) and the filler rods (8) fills the V-shaped grooves between adjacent pins (7) thereby fixing the pins (7) in their positions relative to each other and subsequently bonding an optical fiber (10) in the elongated fiber receiving passageway (9).

10. Method according to claim 9, **characterized in that** three pins (7) are inserted into the sleeve (6).

11. Method according to claim 9, **characterized in that** five pins (7) are inserted into the sleeve (6).

12. Method according to one of claims 9 to 11, **characterized in that** the filler rods (8) in their undeformed state have a circular cross-sectional area and are inserted into the V-shaped grooves between adjacent pins (7).

13. Method according to one of claims 9 to 11, **characterized in that** the filler rods (8) in their undeformed state have a triangular cross-sectional area and are inserted into the V-shaped grooves between adjacent pins (7).

14. Method according to one of claims 9 to 11, **characterized in that** the filler rods (8) in their undeformed state have a polygonal cross-sectional area and are inserted into the V-shaped grooves between adjacent pins (7).

15. Method according to one of claims 9 to 14, **characterized in that** the pins (7) are made of hardened stainless steel whereas the sleeve and filler rods (6, 8) are made of non-hardened stainless steel.

16. Method according to one of claims 9 to 15, **characterized in that** the diameter reducing process of the sleeve (6) comprises the step of subjecting the sleeve (6) to a rotary forging process.

17. Method according to one of claims 9 to 15, **characterized in that** the diameter reducing process of the sleeve (6) comprises the step of subjecting the sleeve (6) to a drawing process.

18. Method according to one of claims 9 to 15, **characterized in that** the diameter reducing process of the sleeve (6) comprises the step of subjecting the sleeve (6) to a pressing process.

Patentansprüche

1. Faseroptisches Anschlußstück mit einer Hülse (6), die eine Vielzahl von Stiften (7) aufnimmt, die gleich beabstandet nebeneinander um die Mittelachse der Hülse (6) angeordnet sind, unter Bildung eines länglichen Faseraufnahmedurchgangs (9) und von Nuten mit V-förmigem Querschnitt, die zwischen benachbarten Außenflächen der Stifte (7) gebildet werden, einer Vielzahl von Füllstäben (8) zwischen der Hülse (6) und den Stiften (7) und einer optischen Faser (10), die sich durch den Faseraufnahmedurchgang (9) erstreckt, **dadurch gekennzeichnet**, daß die V-förmigen Nuten zwischen benachbarten Stiften (7) durch bleibend verformtes Material der Hülse (6) und der verformten Füllstäbe (8), die in die V-förmigen Nuten gedrückt sind, gefüllt werden, und daß die optische Faser (10) in den Faseraufnahmedurchgang (9) eingeklebt ist.

2. Faseroptisches Anschlußstück nach Anspruch 1, **dadurch gekennzeichnet**, daß drei Stifte (7) in der Hülse (6) angeordnet sind.

3. Faseroptisches Anschlußstück nach Anspruch 1, **dadurch gekennzeichnet**, daß fünf Stifte (7) in der Hülse (6) angeordnet sind.

4. Faseroptisches Anschlußstück nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet**, daß die Füllstäbe (8) in ihrem unverformten Zustand einen kreisförmigen Querschnitt besitzen und in den V-förmigen Nuten zwischen benachbarten Stiften (7) angeordnet sind.

5. Faseroptisches Anschlußstück nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet**, daß die Füllstäbe (8) in ihrem unverformten Zustand einen dreieckigen Querschnitt besitzen und in den V-förmigen Nuten zwischen benachbarten Stiften (7) angeordnet sind.

6. Faseroptisches Anschlußstück nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet**, daß die Füllstäbe (8) in ihrem unverformten Zustand einen polygonalen Querschnitt besitzen und in den V-förmigen Nuten zwischen benachbarten Stiften (7) angeordnet sind.

7. Faseroptisches Anschlußstück nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet**, daß die in der Hülse (6) angeordneten Stifte (7) einen höheren Verformungswiderstand aufweisen als die Hülse und die Füllstäbe (6,8).

8. Faseroptisches Anschlußstück nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet**, daß die Stifte (7) aus gehärtetem Edelstahl hergestellt sind, wogegen die Hülse und die Füllstäbe (6,8) aus nicht gehärtetem Edelstahl hergestellt sind.

9. Verfahren zur Herstellung eines faseroptischen Anschlußstückes nach Anspruch 1, bei dem eine Vielzahl von Stiften (7) nebeneinander in einer Hülse (6) so angeordnet werden, daß die Stifte (7) einen länglichen Faseraufnahmedurchgang (9) bilden und die Außenseiten der Stifte V-förmige Nuten bilden, **gekennzeichnet durch** das Einsetzen von Füllstäben (8) in die V-förmigen Nuten und das Verringern des Durchmessers der Hülse (6) durch ein nach innen gerichtetes bleibendes Verformen der Hülse (6) und der Stäbe, so daß verformtes Material der Hülse (6) und der Füllstäbe (8) die V-förmigen Nuten zwischen benachbarten Stiften (7) ausfüllt, wodurch die Stifte (7) in ihrer Lage zueinander festgelegt werden, und durch anschließendes Einkleben einer optischen Faser (10) in den länglichen Faseraufnahmedurchgang (9).

10. Verfahren nach Anspruch 9, **dadurch gekennzeichnet**, daß drei Stifte (7) in die Hülse (6) eingesetzt werden.

11. Verfahren nach Anspruch 9, **dadurch gekennzeichnet**, daß fünf Stifte (7) in die Hülse (6) eingesetzt werden.

12. Verfahren nach einem der Ansprüche 9 bis 11, **dadurch gekennzeichnet**, daß die Füllstäbe (8) in ihrem unverformten Zustand einen kreisförmigen Querschnitt besitzen und in die V-förmigen Nuten zwischen benachbarte Stifte (7) eingesetzt werden.

13. Verfahren nach einem der Ansprüche 9 bis 11, **dadurch gekennzeichnet**, daß die Füllstäbe (8) in ihrem unverformten Zustand einen dreieckigen Querschnitt besitzen und in die V-förmigen Nuten zwischen benachbarte Stifte (7) eingesetzt werden.

14. Verfahren nach einem der Ansprüche 9 bis 11, **dadurch gekennzeichnet**, daß die Füllstifte (8) in ihrem unverformten Zustand einen polygonalen Querschnitt besitzen und die V-förmigen Nuten zwischen benachbarte Stifte (7) eingesetzt werden.

15. Verfahren nach einem der Ansprüche 9 bis 14, **dadurch gekennzeichnet**, daß die Stifte (7) aus gehärtetem Edelstahl hergestellt werden, wogegen die Hülse und die Füllstäbe (6,8) aus nicht gehärtetem Edelstahl hergestellt werden.

16. Verfahren nach einem der Ansprüche 9 bis 15, **dadurch gekennzeichnet**, daß das den Durchmesser der Hülse (6) verringernde Verfahren den Schritt aufweist, daß die Hülse (6) einem Walzprozeß ausgesetzt wird.

17. Verfahren nach einem der Ansprüche 9 bis 15, **dadurch gekennzeichnet**, daß das den Durchmesser der Hülse (6) verringernde Verfahren den Schritt aufweist, daß die Hülse (6) einem Ziehprozeß ausgesetzt wird.

18. Verfahren nach einem der Ansprüche 9 bis 15, **dadurch gekennzeichnet**, daß das den Durchmesser der Hülse (6) reduzierende Verfahren den Schritt aufweist, daß die Hülse (6) einem Preßprozeß ausgesetzt wird.

Revendications

1. Bout de connecteur à fibre optique ayant un manchon (6) logeant une pluralité de broches (7) disposées côte à côte de façon équidistante autour de l'axe central du manchon (6) afin de former une voie de passage allongée de réception de fibre (9) et des creux de section transversale en forme de V qui sont formés entre les surfaces extérieures adjacentes des broches (7), une pluralité de tiges de remplissage (8) entre le manchon (6) et les broches (7) et une fibre optique (10) s'étendant d'un bout à l'autre de la voie de passage de réception de fibre (9), caractérisé en ce que les creux en forme de V entre les broches adjacentes (7) sont remplis par le matériau du manchon (6) déformé en permanence et les tiges de remplissage déformées (8) qui sont pressées dans lesdits creux en forme de V et en ce que la fibre optique (10) est collée dans ladite voie de passage de réception de fibre (9).

2. Bout de connecteur à fibre optique selon la revendication 1, caractérisé en ce que trois broches (7) sont disposées à l'intérieur du manchon (6).

3. Bout de connecteur à fibre optique selon la revendication 1, caractérisé en ce que cinq broches (7) sont disposées à l'intérieur du manchon (6).

4. Bout de connecteur à fibre optique selon l'une quelconque des revendications 1 à 3, caractérisé en ce que les tiges de remplissage (8) dans leur état non déformé ont une section en coupe transversale circulaire et sont disposées à l'intérieur des creux en forme de V entre les broches adjacentes (7).

5. Bout de connecteur à fibre optique selon l'une quelconque des revendications de 1 à 4, caractérisé en ce que les tiges de remplissage (8) dans leur état non déformé ont une section en coupe transversale triangulaire et sont disposées à l'intérieur des creux

en forme de V entre les broches adjacentes (7).

6. Bout de connecteur à fibre optique selon l'une quelconque des revendications de 1 à 4, caractérisé en ce que les tiges de remplissage (8) dans leur état non déformé ont une section en coupe transversale polygonale et sont disposées à l'intérieur des creux en forme de V entre les broches adjacentes (7).

7. Bout de connecteur à fibre optique ou procédé selon l'une quelconque des revendications 1 à 6, caractérisé en ce que les broches (7) disposées à l'intérieur du manchon (6) ont une plus grande résistance contre la déformation que le manchon et les tiges de remplissage (6, 8).

8. Bout de connecteur à fibre optique ou procédé selon l'une quelconque des revendications de 1 à 7, caractérisé en ce que les broches (7) sont en acier inoxydable trempé alors que le manchon et les tiges de remplissage (6, 8) sont en acier inoxydable non trempé.

9. Procédé de fabrication d'un bout de connecteur à fibre optique selon la revendication 1, comprenant l'étape de positionnement d'une pluralité de broches (7) côte à côte dans un manchon (6) d'une manière telle que les broches (7) définissent une voie de passage allongée de réception de fibre (9) et que les surfaces externes des broches forment des creux en forme de V, caractérisé par l'insertion de tiges de remplissage (8) dans les creux en forme de V et par les étapes de réduction du diamètre du manchon (6) par déformation permanente vers l'intérieur du manchon (6) et des tiges afin que le matériau déformé du manchon (6) et des tiges de remplissage (8) remplisse les creux en forme de V entre les broches adjacentes (7), en fixant par ce moyen les broches (7) dans leurs positions les unes par rapport aux autres et en collant ensuite une fibre optique (10) dans la voie de passage allongée de réception de fibre (9).

10. Procédé selon la revendication 9, caractérisé en ce que trois broches (7) sont insérées dans le manchon (6).

11. Procédé selon la revendication 9, caractérisé en ce que cinq broches (7) sont insérées dans le manchon (6).

12. Procédé selon l'une quelconque des revendications de 9 à 11, caractérisé en ce que les tiges de remplissage (8) dans leur état non déformé ont une section en coupe transversale circulaire et sont insérées dans les creux en forme de V entre les broches adjacentes (7).

13. Procédé selon l'une quelconques des revendications 9 à 11, caractérisé en ce que les tiges de remplissage (8) dans leur état non déformé ont une section en coupe transversale triangulaire et sont insérées dans les creux en forme de V entre les broches adjacentes (7) .

14. Procédé selon l'une quelconque des revendications 9 à 11, caractérisé en ce que les tiges de remplissage (8) dans leur état non déformé ont une section en coupe transversale polygonale et sont insérées dans les creux en forme de V entre les broches adjacentes (7).

15. Procédé selon l'une quelconque des revendications de 9 à 14, caractérisé en ce que les broches (7) sont en acier inoxydable trempé alors que le manchon et les tiges de remplissage (6, 8) sont en acier inoxydable non trempé.

16. Procédé selon l'une quelconque des revendications 9 à 15, caractérisé en ce que le traitement de réduction de diamètre du manchon (6) comprend l'étape de soumission du manchon (6) à un traitement de forgeage rotatif.

17. Procédé selon l'une quelconque des revendications 9 à 15, caractérisé en ce que le traitement de réduction de diamètre du manchon (6) comprend l'étape de soumission du manchon (6) à un traitement d'étirage.

18. Procédé selon l'une quelconque des revendications 9 à 15, caractérisé en ce que le traitement de réduction de diamètre du manchon (6) comprend l'étape de soumission du manchon (6) à un traitement d'emboutissage.

FIG.1

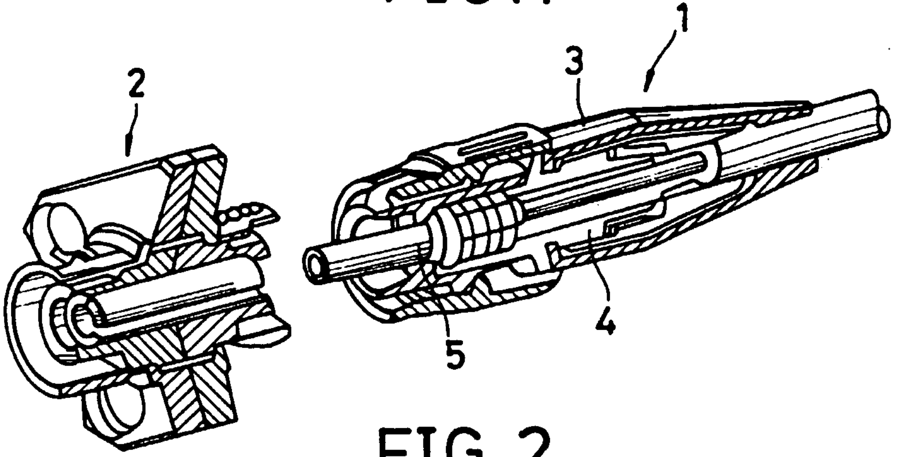

FIG.2

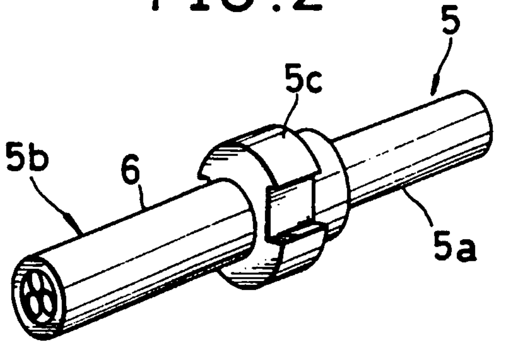

FIG.3

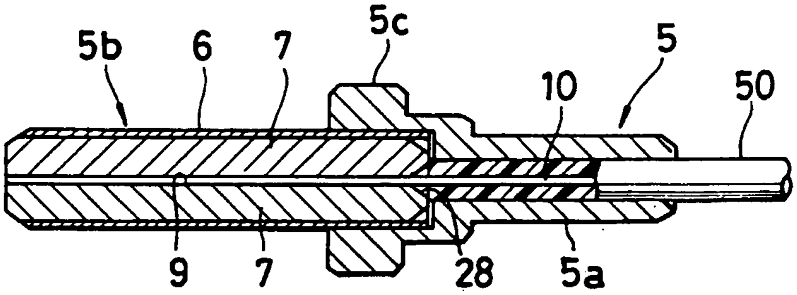

FIG.4

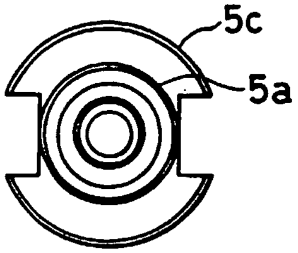

FIG.5

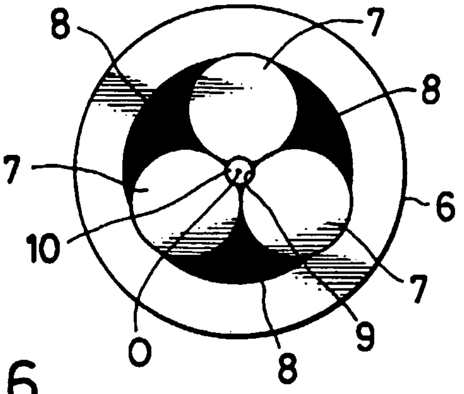

FIG.6

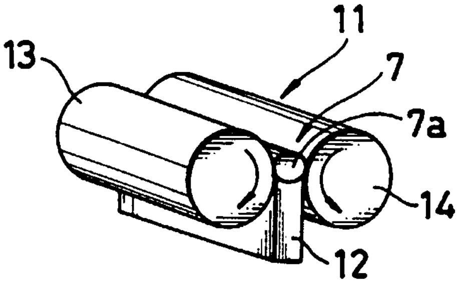

FIG.7

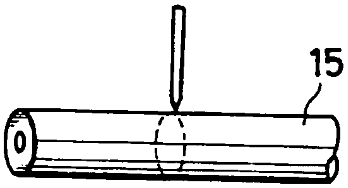

FIG.8

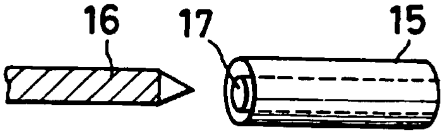

FIG.9

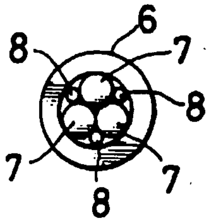

FIG.10

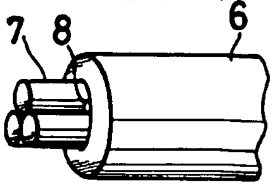

FIG.11

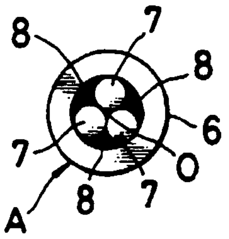

FIG.12

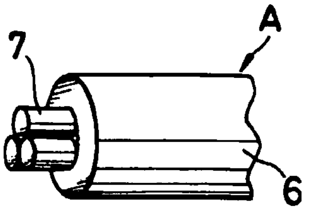

FIG.13

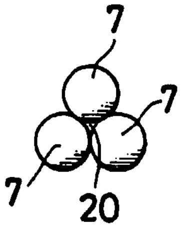

FIG.14

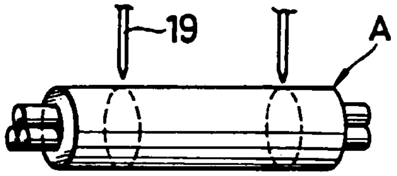

FIG.15

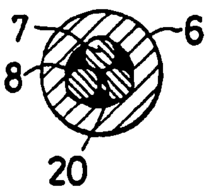

FIG.16

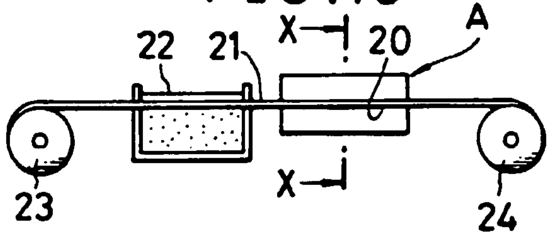

FIG.17

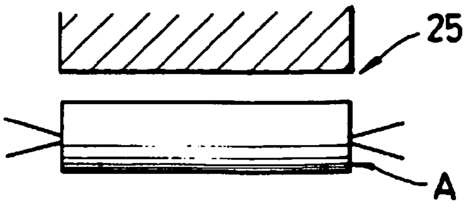

FIG.18

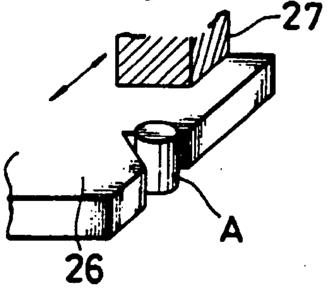

FIG.19

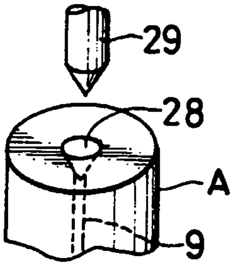

FIG.20

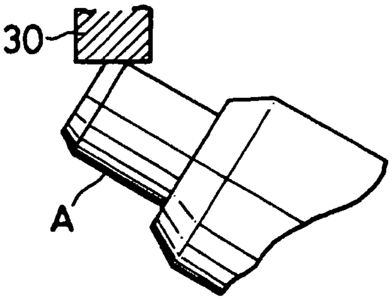

FIG.21

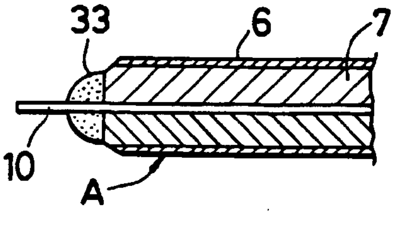

FIG.22

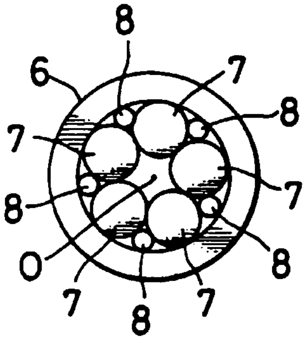

FIG.23

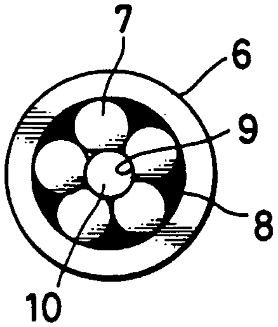

FIG.24